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Abstract

FACTORS CONTROLLING THE REACTION BETWEEN GRAPHITE AND RADIOLYSED CARBON DIOXIDE

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The paper reviews information obtained from basic investigation carried out in rigs in materials testing reactors by the United Kingdom Atomic Energy Authority on the radiation induced reaction between carbon dioxide and graphite. C-14 tracer techniques have been particularly useful in this work and their development and application have therefore been especially selected for description.

The principal parameters governing the reaction have been found to be the gas density and the porous structure of the graphite. In particular the reaction rate depends on the volume of the pores accessible to the external atmosphere and the amount of radiation energy absorbed by gas in these pores. Temperature and pressure have little specific effect apart from controlling the gas density and therefore the energy absorbed. The reaction is described in terms of the formation of active species in the gas within the porous structure; these migrate to and react with a carbon surface. Activated carbon dioxide molecules and oxygen atoms have been postulated as two types of active species. It is possible that both are important under different conditions.

The effects of attack on the graphite structure after massive (up to 19%) weight losses are described in terms of opening up of the closed pore structure. It is suggested that two types of closed pore are involved -

(1) macropores which are similar in character to the open pores, and which open up rapidly during the early stages of the oxidation, and

(2) micropores which may be part of the crack structure and which open up in proportion to the carbon removed.

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Small quantities of additives to the carbon dioxide can have a disproportionate effect on the reaction rate, and limited inhibition was observed with carbon monoxide, hydrogen and water vapour. Methane has been shown to be even more effective. The effects have been attributed to interference with surface processes.